Production of fertile progeny from interspecific incompatible cross *Cajanus platycarpus* × *C. cajan*

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Wild species of crop plants are placed in different gene pools based on their crossability with cultivated species. Closely related species are placed in primary or secondary gene pools. Species, which are distantly related and are incompatible with cultivated species, are placed in the tertiary gene pool. Wild species in primary and secondary gene pool are amenable to crossability techniques and can be utilized for the improvement of the species.

Although pigeonpea (*Cajanus cajan*) is endowed with a rich germplasm in its compatible gene pool, there was immense interest in *C. platycarpus*, a wild species in the tertiary gene pool. *Cajanus platycarpus* has many desirable characters such as extra-early flowering and maturity, photoperiod insensitivity, prolific flowering and pod setting, true annuality, rapid seedling growth (Mallikarjuna and Moss 1995), salinity tolerance (Subbarao 1988, Srivastava et al. 2006) and resistance to Phytophthora blight (Reddy et al. 1996, Mallikarjuna et al. 2005, 2006), pod borers and cyst nematode (Saxena et al. 1996).

Embryo rescue and tissue culture techniques were developed and successfully utilized to recover aborting F_1 hybrids (Mallikarjuna and Moss 1995, Mallikarjuna 1999). F_1 hybrids were pollen sterile, but female fertile. Their morphology was intermediate between the two parents. *Cajanus platycarpus* has trailing growth habit and cultivated pigeonpea plant grows upright. F_1 hybrids were obtained by rescuing the aborting hybrid embryos in vitro. Morphologically F_1 hybrids had intermediate growth habit with upright main stem and semi-trailing branches (Fig. 1). All the pollen in the F_1 hybrids was sterile. F_1 hybrids were backcrossed to cultivated pigeonpea and BC_1 hybrid pods with aborting seeds were obtained. Embryo rescue technique was used again to obtain BC_1F_1 hybrids. Morphologically BC_1F_1 plants had intermediate growth habit with semi-trailing branches. Compared to F_1, BC_1F_1 appeared more erect (Fig. 1). Pollen fertility in BC_1F_1 hybrids varied from 15 to 26%.

BC_1F_1 hybrids flowered profusely but did not set any seeds from self-pollinations but set both mature and immature seeds when backcrossed to cultivated pigeonpea. Only mature BC_1F_1 seeds were selected and plants raised to backcross with ICPL 85010 and obtain BC_2F_1. BC_2F_1 plants resembled cultivated pigeonpea in their morphology, with erect growth habit (Fig. 1).

BC_2F_1 plants did not set seed from self-pollinations, but when backcrossed to cultivated pigeonpea, yielded a large number (>100 seeds) of mature seeds. A detailed study was carried out on BC_2F_1 plants. Variation was observed in BC_2F_1 plants with respect to flower color, flower morphology, seed color, seed morphology and pollen fertility (Table 1). BC_2F_1 was the first generation obtained through mature seeds generation. Although pollen fertility was high in BC_2F_1-E plant, seeds were black in color as in the wild species *C. platycarpus*.

Table 1. Variation for some traits in BC_2F_1 plants from the cross *Cajanus platycarpus* × *C. cajan*.

BC_2 plants	Flower color	Flower morphology	Seed color	Seed morphology	Pollen fertility (%)
BC_2F_1-A	Light yellow	Normal	Brown	Oval	36
BC_2F_1-B	Light yellow	Normal	Brown	Oval	22
BC_2F_1-C	Light yellow	Normal + Open	Brown	Oval	67
BC_2F_1-D	Light yellow	Open	Brown	Elongate	43
BC_2F_1-E	Orange yellow	Open	Black	Oval	72

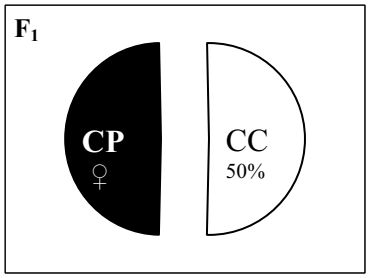
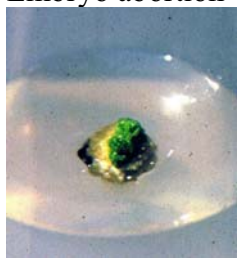
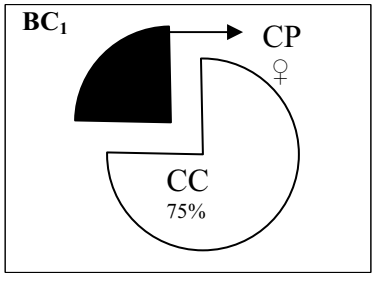
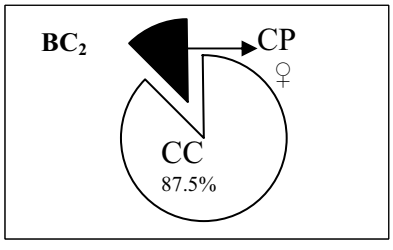
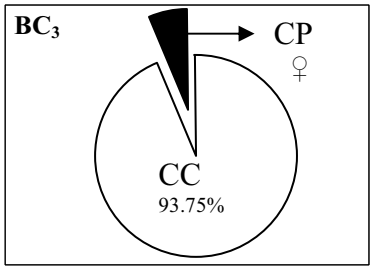
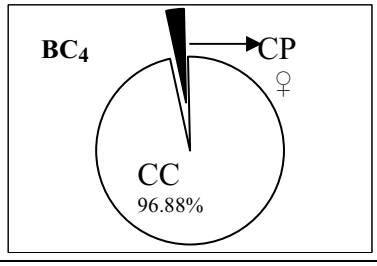
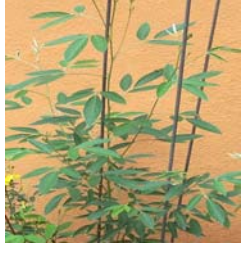
Generation and genome composition (theoretically)	Morphology of the hybrid	Hybrid seed status	Pollen fertility (%)
		Embryo abortion 	0-1
		Embryo abortion 	15-26
		Mature seeds 	38-41
		Mature seeds 	55-66
		Mature seeds 	51-73

Figure 1. Generation of fertile progeny from the cross *Cajanus platycarpus* (CP) × *C. cajan* (CC).

Segregation for flower morphology was also observed in BC_2F_1 plants. BC_2F_1-A plant was backcrossed to obtain BC_3F_1 seeds.

Seeds from self-pollinations were obtained only in BC_4F_1 plants. Seeds resembled those of cultivated pigeonpea in color and morphology. Theoretically it can be stated that 87% of cultivated pigeonpea genome on cytoplasm of *C. platycarpus* is essential for mature seed set (after backcross with pigeonpea) whereas 97% genome of pigeonpea (one more backcross) is essential to achieve normal fertility (natural selfed and mature seeds) (Fig. 1).

Field evaluation of BC_4F_1 plants showed variation for plant type, number of secondary branches, basal flower color, flowering pattern, pod color, shape and size, seed shape, number of seeds per plant and pollen fertility.

This is the first report where any wild species from tertiary gene pool of *Cajanus* has been successfully crossed and fertile hybrids obtained.

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